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BAGNULO HEAVY FUEL INTERNAL COMBUSTION ENGINE AND ITS EMPLOYMENT IN AVIATION

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By

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In the transition of aviation from military to civilian uses, it has undergone important modifications. Safety of passengers has become the first and most troublesome problem. The inflammability of gasoline unfortunately entails serious disadvantages. In the second place, the cost per horsepower-hour is a serious drawback, greatly affecting even so simple a matter as mail transportation. From the standpoint of economy, the volatility of gasoline is not negligible in the regions of diminished atmospheric pressure and therefore the fuel consumption per horsepower-hour is greater than on the testing stand, and this aside from all other considerations profoundly affects the fuel consumption.

Thus in civil aviation, the engine, which has always been the most important factor in the problem of flight, has today acquired still greater importance.

We are not far from the epoch, in which the internal combustion engine, after a considerable period of transition and improvement, became reliable and conquered, in its triumphal march, the broadest field of application, especially in the automotive field where it was completely victorious over that wonder-

* From "L'Aeronautica," January-February, 1931, pp. 27-29.

ful machine, the steam engine, and over the electric motor with storage batteries.

Since that time, several decades ago, the imagination and study of inventors has been chiefly devoted to improving the design and to the more or less convenient location of each part, while completely neglecting the improvement of the efficiency and the creation of engines specially adapted to various uses. This neglect was so complete that in the field of aviation we have seen the employment of the automobile engine simply lightened in its various parts, as the result of improvements in metallurgy.

Today, on the contrary, we see with great satisfaction that Bagnulo's studies and experiments on his high-speed, heavy-fuel engines, promise to solve not only the general problem of economical power and hence of thermal efficiency, but also all other special problems, of weight and space, and, what is still more important, range of power. It is, therefore, evident that these studies are very important for aviation.

At present, Mr. Bagnulo is engaged in developing an engine for solving agricultural problems, either by direct application to agriculture or to commercial land and sea transportation. He has always been an enthusiastic student of aviation, to which he has given his best energies, and has not abandoned the idea of rendering further useful service toward the conquest of the air.

We can give some of the first fruits of his experiments, which afford great promise of an early solution, if Mr. Bagnulo is only backed morally and financially in his researches.

The two accompanying diagrams show how Mr. Bagnulo would solve the problem of aviation. We will first confine our attention to the results of his tests, which seem quite conclusive. With a single-cylinder engine of 120 mm. bore and 160 mm. stroke and 1200 r.p.m., he obtained 10 horsepower with a fuel consumption of 311 grams per horsepower-hour, by burning heavy oil at 900°.

The following table gives the comparative results for the Bagnulo and two other aviation engines of similar dimensions.

Type	Bore	Stroke	H.P.	R.P.M.	Stroke Volume	Unit Power	η ρ
	mm.	mm.			liters		
Colombo	120	160	100	1350	1.8	HP 16.6	88.0
Bagnulo	120	160	—	1200	1.8	" 10	59.6
Anzani	105	145	90	1330	1.25	" 9	75.8

The r.p.m. can be readily increased as shown by tests of commercial types. The small 3 HP engine was run as high as 1800 r.p.m. These engines can be made to approximate closely, if not actually attain the power of gasoline engines, though in civil aviation it is not necessary to emulate the acrobatic performances of war engines.

Recently, however, Mr. Bagnulo has given his attention to

the solution of supplemental problems essential to the practical attainment of his purpose.

The two most important problems are: (1) starting and (2) counter-action of the effects of variations in atmospheric pressure, both of which have been completely solved.

Everybody knows that ordinary heavy oil engines have to be started with highly compressed air (60 to 80 atm.). This necessitates delicate compressors, tanks, valves, etc. Besides, it often happens that the tanks become exhausted, either from repeated attempts to start, or from losses which easily occur at such high pressures. This method of starting, with its serious disadvantages, is a source of danger on the water and justifies the apprehensions and hostility of mariners to the propulsion of ships by Diesel and similar engines.

On the contrary, with the special design of the Bagnulo engine, it can be started by simply pumping in a little air and a few drops of fuel, sufficient to form an explosive mixture. The engine is thus started by the impulse of the explosion.

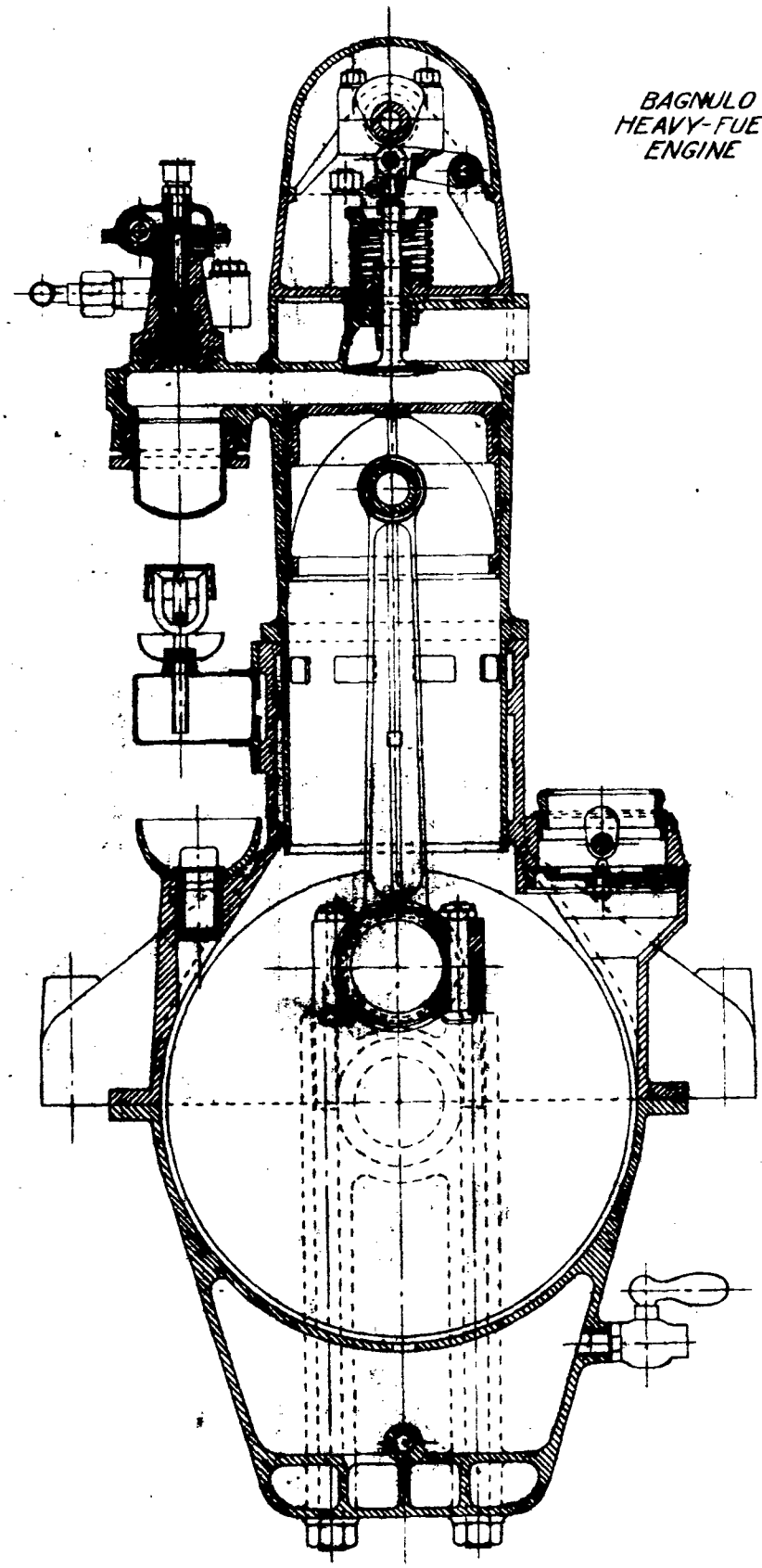
For solving the other problem, that of counteracting the variations in the atmospheric pressure at various altitudes, Bagnulo simply makes use of the lower face of the piston for obtaining the supplementary air, as in two-stroke engines, but this being a four-stroke engine, there are two compression strokes. One is utilized in a portion of the exhaust for cleaning the cylinder (which helps immensely to increase the motive

power) the other increases the weight of the intake air.

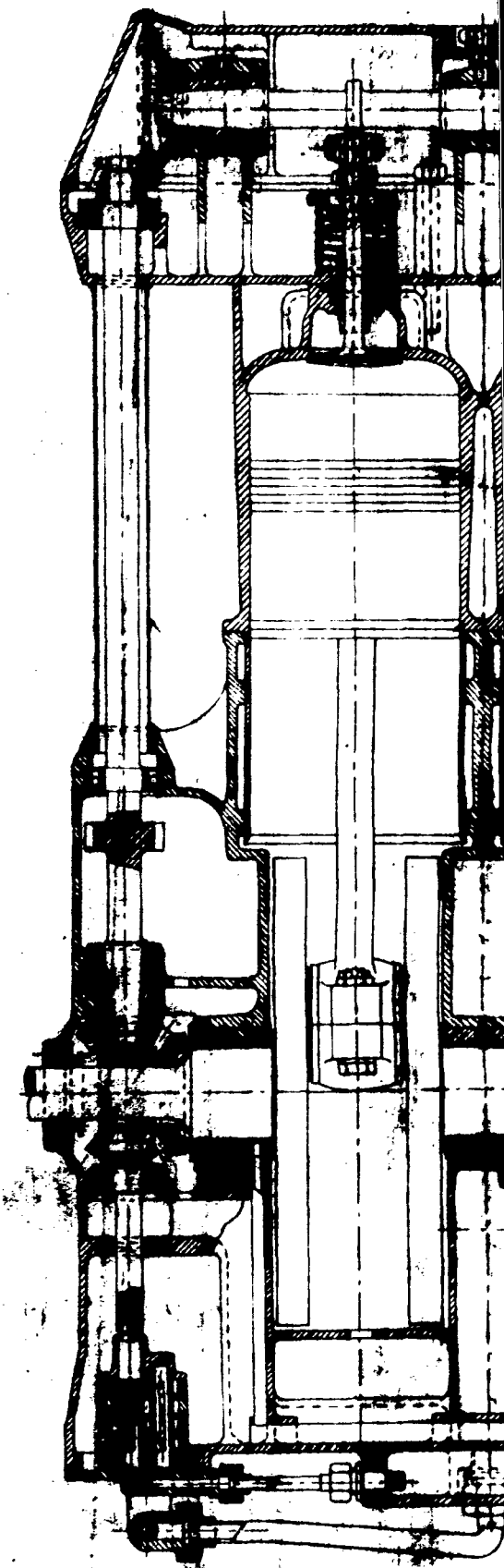
Experiments performed by Bagnulo on a test engine with one cylinder gave very fine results. The accompanying diagrams show the mechanical arrangement of this device, in which there is also shown the special lubricating system with independent channels and a quadruple pump, in order to avoid the compensation of the air chambers through the oil channels and to assume, at the same time a good lubrification of the whole engine.

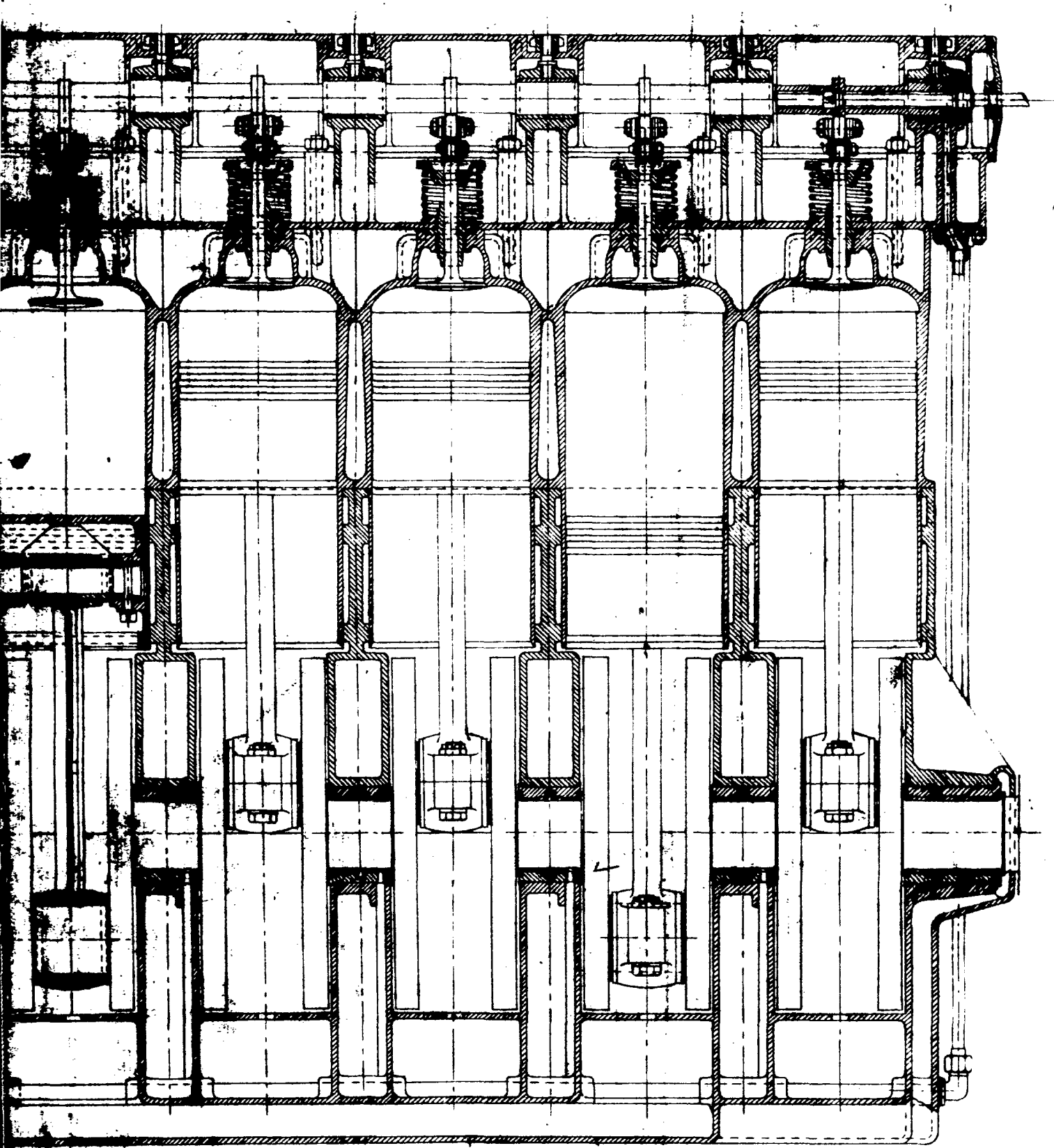
Translated by the National Advisory Committee for Aeronautics.

BAGNULO
HEAVY-FUEL
ENGINE



Cross section





Longitudinal section